IN THE CLAIMS:

Kindly cancel claims 2, 3 and 14 and rewrite Claims 1, 9-11, 13, 15, 16 and 19 as follows:

1. (Currently Amended) A heat radiation shield plate comprising:

a metal substrate, and

a heat radiation shield coating film formed by applying a coating composition to said substrate,

said coating composition containing a black calcined pigment which ~~exhibits a reflectance of not below 8.0 % relative to a solar radiation in the 780 - 2,100 nm wavelength region,~~ contains Fe_2O_3 and also Cr_2O_3 and/or Mn_2O_3 in a total amount of 20-100% by weight; a binder component, a curing agent, and a solvent; said black pigment exhibiting a reflectance of not higher than 15% relative to a radiation at any wavelength in the 400-700 nm visible region and a reflectance of not below 8.0% relative to a solar radiation in the 780-2100 nm wavelength region.

2. (Canceled)

3. (Canceled)

4. (Previously amended) The heat radiation shield plate of

claim 1, wherein said black pigment is contained in the amount of not less than 0.1 % by weight.

5. (Previously amended) The heat radiation shield plate of claim 1, wherein said black pigment is contained in the amount of not less than 0.5 %, based on the total weight of all pigments.

6. (Previously amended) The heat radiation shield plate of claim 1, wherein said coating composition contains a polyester, acrylic, fluoro or chloro resin as said binder component.

7. (Previously amended) The heat radiation shield plate of claim 6, wherein said coating composition contains a melamine resin and/ or blocked isocyanate as said curing agent.

8. (Canceled)

9. (Previously added - currently amended) A heat radiation shield coating composition comprising:

0.1 wt% or more black pigment, a binder component and a curing agent, said black pigment comprising 20 - 100 wt% of a calcined pigment comprising Fe_2O_3 and Cr_2O_3 and/or Mn_2O_3 which exhibits a reflectance of not below 8.0 % relative to a solar radiation in the 780 - 2,100 nm wavelength region~~;~~ and a reflectance of not higher than 15% relative to a radiation at any wavelength in the 400 - 700 nm visible region.

~~a binder component, and~~

~~a curing agent.~~

10. (Previously added - currently amended) The heat radiation shield coating composition of claim 9, wherein the binder component is selected from the group consisting of polyester, acrylic, fluoro ~~or~~ and chloro resins.

11. (Previously added - currently amended) The heat radiation shield coating composition of claim 10, wherein the curing agent ~~consists essentially of~~ is selected from the group consisting of melamine resin, isocyanate and blocked isocyanate.

12. (Previously added) The heat radiation shield coating composition of claim 11, further comprising a filler.

13. (Previously added - currently amended) The heat radiation shield coating composition of claim 12, wherein said filler comprises fine particles, said fine particles consisting essentially of SiO_2, TiO_2, Al_2O_3, ~~Cr2O3, ZrO2, Al2O3·SiO2, 3Al2O3·2SiO2,~~ Cr_2O_3, ZrO_2, Al_2O_3, SiO_2, $3Al_2O_3$, $2SiO_2$; zirconia silicate, ~~and~~ ~~finely divided~~ fibrous glass and ~~or~~ particulate glass.

14. (Canceled)

15. (Previously added - currently amended) The heat radiation shield coating composition of claim ~~14~~ 9, wherein said calcined pigment comprises 30-100 wt% of the black pigment.

16. (Previously added - currently amended) The heat radiation shield coating composition of claim ~~15~~ 9, wherein said

black pigment comprises at least 0.5 wt% based on a total weight of all pigment components.

17. (Previously added) The heat radiation shield coating composition of claim 9, wherein the black pigment comprises 15-75 wt% of Fe_2O_3 and 25-60 wt% of Cr_2O_3.

18. (Previously added) The heat radiation shield coating composition of claim 17, wherein said black pigment further comprises 15-20 wt% of Mn_2O_3.

19. (Previously added - currently amended) The heat radiation shield coating composition of claim 9, further comprising a solvent selected from the group consisting of toluene, xylene, ~~SOLVESSO 100, SOLVESSO 150,~~ ethyl acetate, butyl acetate, methylethyl ketone, methylisobutyl ketone, cyclohexanone, isophorone and water.

REMARKS

The Examiner is thanked for the very thorough and professional Office Action. Pursuant to that action, Claims 2, 3 and 14 have been canceled, and Claims 1, 9-11, 13, 15, 16 and 19 rewritten, to more definitely set forth the invention and obviate the rejection. Claim 1 has been rewritten to incorporate the limitations of Claims 2 and 3. Support for the amendment of Claim 9 can be found in the Specification on page 3, lines 3-5, and in original Claim 2. Also, the dependency of Claim 15 has been changed from Claim 14 to 9 and the dependency of Claim 16 has been changed from Claim 15 to 9. In addition, Claim 19 has been amended to delete reference to SOLVESSO 100 and SOLVESSO 150. The present amendent is deemed not to introduce new matter. Claims 1, 4-7, 9-13 and 15-19 remain in the application.

Reconsideration is respectfully requested of the rejection of Claims 11 and 14-16 under 35 U.S.C. § 112, first paragraph.

Support for the use of melamine resin, isocyanate and blocked isocyanate can be found in the Specification on page 7, lines 7-10, and these curing agents are now set forth in a Markush group. In addition, Claim 14 has been canceled and the

dependency of Claims 15 and 16 changed so that they are now dependent on Claim 9. Further, Claim 9 has been amended to provide the proper support for the terms in the dependent Claims 15 and 16. It is therefore believed that the rejection is no longer applicable and the rejection is now moot. Withdrawal of the rejection is accordingly respectfully requested.

Reconsideration is respectfully requested of the rejection of Claims 10, 11, 13 and 19 under 35 U.S.C. § 112, second paragraph, as being indefinite. Claims 10 and 11 have been amended to set forth the components in proper Markush language, and Claim 13 has been amended to correct typographical errors. In addition, the reference in Claim 19 to SOLVESSO 100 and SOLVESSO 150 has been deleted. It is therefore believed that with these amendments the rejections are now moot. Withdrawal of the rejections is accordingly respectfully requested.

Reconsideration is respectfully requested of the rejection of Claims 1, 2 and 4-7 under 35 U.S.C. § 102(b)as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Yamada, et al., and the rejection of Claims 9, 10 and 14-19 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Nakamura, et al.

The present invention as now claimed calls for a heat radiation shield plate comprising a metal substrate and a heat

radiation shield coating film formed by applying the coating composition to the substrate (Claims 1-7). Also, Claims 9-13 and 15-19 call for a heat radiation shield coating composition comprising a binder component and a curing agent and a black pigment.

The black pigment contained in the coating composition is a calcined pigment which contains Fe_2O_3 and also Cr_2O_3 and/or Mn_2O_3 in a total amount of 20 - 100% by weight. Both independent Claims 1 and 9 contain the limitation that the black calcined pigment exhibits a reflectance of not higher than 15% relative to a radiation at any wavelength in the 400 - 700 nm visible region and a reflectance of not below 8.0% relative to a solar radiation in the 780- 2100 nm wavelength region.

The importance of the use of the black calcined pigment having these reflectance properties is illustrated in Examples 1-12 appearing on pages 13-18 of the Specification, and in the comparative examples appearing in the Specification on pages 18-21. Each of these pigments was dispersed in a binder at a composition of 20 - 40 parts by weight to obtain a coating film. Then, the spectral reflectance of each coating film containing black pigments AH, respectively, was measured by Hitachi Seisakusho Spectrophotometer in the 780 - 2100 nm near infrared region.

Based on these measured reflectances, the solar radiation reflectance of each black pigment was calculated according to the procedure described in JIS A 5759, which is discussed on page 12, lines 17-24. Then, as described in Example 1, a coating composition was prepared and coated on an aluminum substrate test piece which was then measured for Munsell System dimensions and gloss. Further, spectral reflectance was also measured to calculate the solar radiation reflectance of the test piece from which the solar radiation reflectance of the coating film was calculated.

Thereafter, the heat radiation shielding ability of coating compositions was measured as described on pages 14, line 8, to page 15, line 7. In these tests, temperature measurements were taken to measure the heat shielding/insulating ability of the coating composition in preventing heat transfer from solar radiation across the substrate to which the coating composition had been applied.

Thereafter, numerous coating compositions were prepared as described in Examples 2-12 and comparative examples 1-12, and the measurements described above in Example 1 performed on each of these coating compositions. The results of these tests and calculations are set forth in Tables 1 and 2 of the Specification on pages 22 and 23.

The data obtained was plotted in Figs. 1, 3 and 4 and the type of test box on which the temperature was measured is depicted in Fig. 2.

It was unexpectedly discovered by the present inventors that the combination of the particular black pigment, binder and curing agent coated on the test sample resulted in a saturation temperature, either at the back of the substrate (test piece) or inside the test box shown in Fig. 2 that was lower than when using the other black pigmented films as in the comparative examples.

Importantly, this difference in saturation temperature inside the test box varies depending upon the color hue of the corresponding coating films, and becomes larger, about 2-9°C, when their color hue is darker. The results of the tests and comparative tests are described in Tables 1 and 2 as well as Figs. 1 and 4. It can be seen that the inventors unexpectedly discovered that the application of the claimed coating composition of the present invention onto an exterior of a structure provides unexpectedly improved insulating properties as compared to the prior art coating compositions when the structure is subjected to UV/solar radiation, i.e., the exterior of a building coated with the coating composition of the present invention.

This data also demonstrates that this coating composition can be used to absorb and/or reflect a higher degree of solar radiation when applied to a metal substrate without a subsequent increase in the interior temperature of the building. This insulating property is particularly important since it provides a temperature difference and substantial effect on the comfort of a residential space, indoor air-conditioning efficiency in storage articles. This data also confirms that the coating films of the examples have excellent heat and solar radiation shielding capabilities.

Neither Yamada, et al. nor Nakamura, et al. disclose the heat radiation shield coating composition and heat radiation shield plate having a coating thereon in which the coating composition contains a black calcined pigment containing 20 - 100% by weight of Fe_2O_3 and also Cr_2O_3 and/or Mn_2O_3 wherein the coating composition exhibits a reflectance of not below 8.0% relative to solar radiation in the 780 - 2100 nm wavelength region and a reflectance of not higher than 15% relative to a radiation at any wavelength in the 400 nm visibe region. On the contrary, that teaching or suggestion comes only from the present application and constitutes an important element or aspect of the present invention.

The limitation that the black pigment exhibits a reflectance

of not higher than 15% relative to a radiation at any wavelength in the 400 - 700 nm visible region means that the black pigment is intentionally black because of low reflectance in the visible region. In this connection, Fig. 3 of the present application shows black pigments A and D according to the present invention exhibit low reflectance, not higher than 15% at any wavelength in the 400 - 700 nm visible region.

None of the prior art relied upon by the Examiner discloses this important limitation of the claims as amended. As the test data shows, the conventional black pigments do not exhibit a reflectance of not higher than 15% relative to a radiation at any wavelength in the 400 - 700 nm visible region.

Attached as Exhibit A is a copy of an informational article by Gil Burkhart, entitled "The Effect of IR Reflecting Black Pigment Selection On Weatherable R-PVC", presented at a technical conference in St. Louis on October 1 and 2, 1996 on pages 187-199.

As pointed out in the introduction to the Burkhart article, there are essentially three basic types of IR reflecting black pigments evaluated with regard to color and composition. One was a CI pigment black 30 (CrFeNiMn), CI, pigment green 17 CrFe, 11% Fe), and CI, pigment green 17 (CrFe, 34% Fe). These pigments exhibited a reflectance in the range of 36 - 53% at 700 nm (see

Fig. 5 which shows the IR reflectance of black pigments versus the wavelength.

It can be seen that these conventional black pigments do not exhibit low reflectance, as called for in the claims herein, i.e., a reflectance not higher than 15% at any wavelength in the 400 - 700 mn visible region. The same holds true with respect to the prior art black pigments which are nowhere disclosed as having the characteristics of the black pigments of the present invention.

For these reasons, it is respectfully submitted that neither Yamada, et al. nor Nakamura, et al. anticipate or render unpatentably obvious the subject matter now called for in the claims herein.

This is particularly true in view of the unexpected discovery of the applicants herein that the calcined black pigments used in the coating composition of the present invention provides unexpectedly improved insulating properties, particularly for buildings and metal surfaces. These unexpected results can clearly be seen in the test data set forth in Tables 1 and 2 and also in the Figs. 1 and 3 and 4. Consequently, the Examiner would be justified in no longer maintaining the rejection. Withdrawal of the rejection is accordingly respectfully requested.

Reconsideration is respectfully requested of the rejection of Claims 1-7, 9-17 and 19 under 35 U.S.C. § 103(a) as being unpatentable over Piana in view of Ravinovitch, et al. or Modly.

There is no disclosure whatever in any of the Examiner's references, taken individually or in combination, of a heat radiation shield coating composition as now called for in the claims herein wherein the calcined black pigment exhibits reflectance of not below 8% relative to a solar radiation in the 780 - 2100 nm wavelength region and a reflectance of not higher than 15% relative to a radiation of any wavelength in the 400 - 700 nm visible region. On the contrary, that teaching or suggestion comes only from the present application and constitutes an important element of the present invention.

Moreover, there is no suggestion or hint in any of the references relied upon that they could be combined in the manner suggested by the Examiner to arrive at a heat shield coating composition having the reflectance characteristics as now called for in the claims herein. As pointed out above, the attached Burkhart reference illustrates the reflectance characteristics of conventional black pigments, such as the pigments in the prior art relied upon.

None of the conventional prior art including those relied upon by the Examiner disclose a calcined black pigment having

these reflective properties. The importance of these reflective properties is highlighted in the test results set forth in Tables 1 and 2 and in Figs. 1 and 3-4 which illustrate the surprising insulating properties of the coating compositions containing these calcined black pigments. For these reasons, it is respectfully submitted that the unexpected results set forth in the present application should not be ignored in evaluating the importance of this invention.

Patentable unobvious does not depend upon a showing of advantages or improvements but upon obviousness, Ex parte Parthasarathy, et al., 174 USPQ 63 (POBA, 1971). However, proof of an unexpected improvement can rebut a prima facie case of obviousness. In re Murch, 464 Fed2d 1051 (CCPA, 1972).

In the present case, it is respectfully submitted that the applicant has submitted unequivocal proof that the heat radiation shield coating composition and heat radiation shield plate of the present invention provides unexpectedly improved insulating properties. It is respectfully submitted that this test data refutes any prima facie case of obviousness based on the prior art of record. This is particularly true since the prior art of record is entirely silent as to such a coating composition having the properties of the coating composition of the present invention. Therefore, it is respectfully submitted that the

Examiner would be justified in no longer maintaining this rejection. Withdrawal of the rejection is accordingly respectfully requested.

Reconsideration is respectfully requested of the rejection of Claims 9–17 and 19 under 35 U.S.C. § 103(a) as being unpatentable over O'Neil in view of Ravinovitch, et al.

As pointed out above, none of the prior art of record, including O'Neil and Ravinovitch, et al. disclose the radiation shield coating composition and heat radiation shield plate as now called for in the claims herein. For this reason, it is respectfully submitted that the Examiner would be justified in no longer maintaining this rejection. Withdrawal of the rejection is accordingly respectfully requested.

In view of the foregoing, it is respectfully submitted that the application is now in condition for allowance, and early action and allowance thereof is accordingly respectfully requested. In the event there is any reason why the application cannot be allowed at the present time, it is respectfully requested that the Examiner contact the undersigned at the number listed below to resolve any problems.

Respectfully submitted,

TOWNSEND & BANTA

Donald E. Townsend
Reg. No. 22,069

TOWNSEND & BANTA
601 Pennsyvania Ave., N.W.
Suite 900, South Building
Washington, D.C. 20004
(202) 220-3124

Date: August 5, 2003

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The Effect of IR Reflecting Black Pigment Selection on Weatherable R-PVC

Gil Burkhart
Cordec Corporation
Washington, Pennsylvania

Introduction:

IR Reflecting Black pigments are commonly used in R-PVC applications where excellent weatherability and low "heat build-up" are primary requirements. A few of the application areas with these requirements are vinyl siding and vinyl window profiles. In both of these areas, the color hold or weatherability and the degree of heat build-up are key factors in the products performance. It has been well documented that the IR reflecting black pigments give superior performance with regard to heat build-up over other alternate black pigments (Carbon Black, Copper chromes, ...).

Within the IR reflecting black pigments, essentially three basic types with regard to color and composition can be defined. One area is covered by Pigment Black 30's - CrFeNiMn (approx. 18% as Fe), which are typically blue/green in shade. The other two types are both classified as [1]Pigment Green 17's (CrFe) which differ with respect to the Cr:Fe ratio. The two regions can be classified as approximately 11% Fe containing pigments, which are in the red/yellow color space and approximately 34% Fe containing pigments, which are red/blue in shade(Figure 1). The aim of this paper is to try to differentiate the performance of the three black pigment ranges as individual pigments and in a few typical vinyl siding shades.

The Design: (also see the "General Information" attachment)

Although, IR Reflecting black pigments are the primary pigment used in gray vinyl siding shades, they are used more often in combination with C.I. Pigment Brown 24's(CrSbTi's) & C.I. Pigment Yellow 164's(MnSbTi's) to make a wide variety of shades. The design of this study is to look at the heat build-up and weathering of the individual black pigments(gray) and to also evaluate their performance in a few typical siding shades - light, medium, and dark beige(Figures 2 - 4).

The R-PVC compound used for this report is Tin Mercaptide stabilized and contains 10phr TiO_2. All IR Reflecting black pigments used are commercially available codes with one C.I. Pigment Black 30(~18% Fe) and one C.I. Pigment Green 17(~34% Fe) being used. However, since there is a wider range of pigments in the C.I. Pigment Green 17, "low Fe" area that vary somewhat in both % Fe content and shade, the results reported for C.I. Pigment Green 17(~11% Fe) are average values from three commercially available grades.

The light, medium, and dark beige shades results reported are averages of a number of color matches where the match consisted of combination of an IR Reflecting black pigment, a C.I. Pigment Yellow 164 and a C.I. Pigment Brown 24. Chrome oxide green was used as a shading component when necessary. The IR reflecting black and C.I Brown 24 pigments for each match were varied, while a single C.I. Yellow 164 pigment was used in all matches. In compiling the results, the C.I. Brown 24 pigments used showed very little variation with regard to IR

[1] It should be noted that some commercially available pigments considered as C.I. Pigment Green 17's in this paper are classified as C.I. Pigment Brown 35's according to their manufacturers.

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reflectance and weathering performance. Therefore, although a number of commercially available CrSbTi's were used, they were considered for reporting purposes to be a single pigment.

All weathering results were from South Florida outdoor weathering - ASTM #G7-89 guidelines were followed. The % IR reflectance was measured on a Datacolor CS9000 spectrophotometer. Heat build-up results were compiled using a Cerdec designed unit, which does not conform to the ASTM D4803 specification. Therefore the heat build-up results are used for relative comparisons only.

The Results:

In looking at the individual black pigment types, some clear differences are apparent. The Pigment Black 30 contains ~18% Fe, while the two Pigment Green 17's contain ~11 and ~34% Fe, respectively(General Info. attachment). The IR reflectance/Heat build-up results(Figures 5 - 12) on the individual black pigment types show that the Pigment Black 30 has lower % IR Reflectance by approximately 10 - 20% than either of the Pigment Green 17's and therefore a higher degree of heat build-up, 10 - 15°C. The one year South Florida weathering results(Figure 13) show that the Pigment Black 30 is weathering the best at this stage, followed by the ~11% Fe containing C.I. Pigment Green 17, and the poorest weathering is exhibited by the ~34% Fe containing black. Since Fe is well known to have a deleterious effect on R-PVC, these results are not surprising.

For the "matched shades" the % IR Reflectance and heat build-up results show exactly the same trends as seen with the individual black pigments(Figures 7, 9, & 11). However, it is very important to note that the relative differences for both IR Reflectance & Heat Build-up between the matched shades based on the different IR Reflecting black pigments are much smaller than for the individual black pigments. Since Pigment Brown 24 and Pigment Yellow 164 both have higher IR reflectance than any of the IR reflecting blacks the net differences in both % IR Reflectance and Heat Build-up of the matched shades is greatly reduced.

The overall South Florida weathering results on the matched shades show that, again, the Pigment Black 30 based matches give the best weathering results(Figure 14). However, it is interesting to note there is a reversal of the relative weathering results between the Pigment Green 17 type blacks. The matches based on the ~34% Fe containing black, although slightly poorer than the Pigment Black 30 based shades, are are performing better than the matches based on the ~11% Fe containing black pigment. This reversal can not be explained by looking at the average % Fe content of each matched shade(Figure 15). The ~11% Fe containing black matches have a significantly lower Fe content than for the matches based on the ~34% Fe containing black. The one piece of data that shows some correlation to the weathering results on the "beige matches" is the total "parts per hundred weight"(phr) of IR Reflecting black pigment contained in each(Figure 16). These show the Pigment Black 30 based matches contain the least amount of black pigment use, while the matches based on the ~34% Fe containing black show only slightly higher amounts of black pigment use. However, the matches based on ~11% Fe containing black pigment have, by far, the highest loading of black pigment.

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Conclusions/Questions:

1) The heat build-up results show clearly that formulas based on Pigment Black 30 would generally run slightly "hotter" than formulas based on either of the Green 17 type blacks. However, in the color ranges evaluated, the heat build-up differences are relatively small for the "matched shades". One of the most important points to note is that the heat build-up differences seen in this study show no correlation to weatherability.

2) Care should be taken in using weathering of the individual black pigments to predict relative weathering performance of a "matched shade". The weathering results clearly showed that the Green 17 containing ~34% Fe to be the poorest weathering pigment when tested individually, but to have significantly better performance than the 11% Fe containing black when used in making medium and dark beige matches.

3) In trying to determine what factor is influencing the difference in weathering performance of the IR reflecting black pigments, the relative Fe content, surprisingly, showed no correlation to the weathering results. This held true either as individual pigments or in matched shades. As individual pigments the 18% Fe containing Pigment Black 30 showed better weathering results than the ~11% Fe containing Pigment Green 17. In the matched shades, the samples based on the ~34% Fe black pigment contain the highest amounts of Fe. However, the medium and dark beige weathering results clearly showed the shades based on the ~34% Fe black to weather better than the matches based on the ~11% Fe containing black.

4) The best correlation to weathering results is found looking at amount of black pigment used in the matched shades. As the amount of IR Reflecting black pigment increased in both the Medium and Dark beiges, weathering results became poorer. However, although the trend is there, there is not enough data in this study to totally support this theory. One factor not discussed earlier is report is that the Pigment Black 30 crystal is a spinel structure, while the Green 17 crystal is a hematite structure. Obviously not an "Apples to Apples" comparison.

5) Weathering is not an exact science, therefore all work will be both repeated and expanded upon!!!

Future Work:

To advance this work another study will be initiated utilizing a wider range of Pigment Black 30's. Since a number of commercially available versions of this pigment exist which are coloristically identical but differ in tinting strength, it would be expected that medium and beige shades based on the higher strength versions would weather better than the weaker version based on % black pigment content of the final shade. Another factor would be to weather the individual pigments both at equal loading and at equal L* values.

Since it is possible also to vary the shade of Pigment Black 30 from the green/blue shade to a more red/yellow shade, but maintain the identical % Fe content and spinel crystal structure,

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pigments of this type will be included to determine the effect of the overall composition and will elimate some of the coloristic differences when comparing the Pigment Black 30 chemistry Green 17 types.

Acknowledgements:

The author would like to thank B. Bier who spent many hours preparing and evaluating the weathering plaques, G. Rangos & Dr. D. Swiler for their technical guidance and assistance, and Cerdec Corporation for the permission to publish this paper.

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Predicting Heat Buildup in PVC Building Products, ASTM D4803-89, American Society for Testing Materials, Philadelphia, PA

Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials, G7-89, American Society for Testing Materials, Philadelphia, PA

[redacted]

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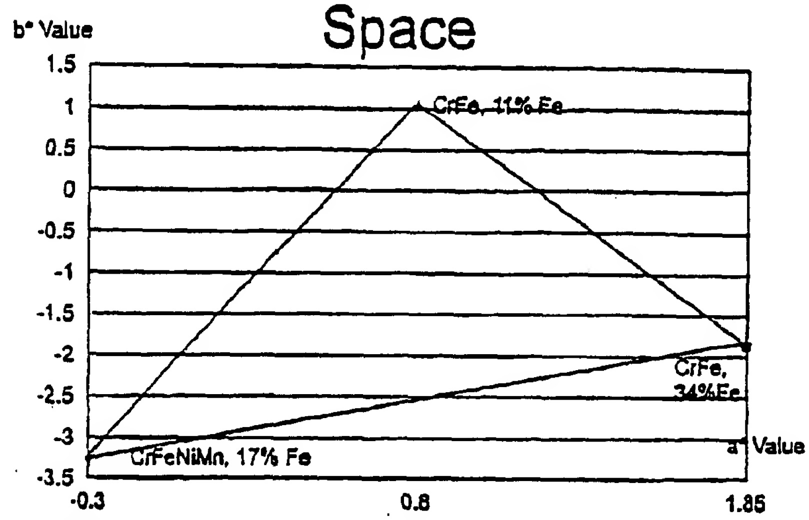
IR Reflecting Blacks - Color Space



CIELAB Ill. D65 @ 10deg., SCI

Figure 1

Light Beige Formulas

Average Composition - In phr

	CrFeNiMn(17% Fe)	CrFe(11% Fe)	CrFe(34% Fe)
Pigment Brown 24(CrSbTi)	0.174	0.149	0.174
Pigment Yellow 164(MnSbTi)	0.035	0.007	
Pigment Black 30(CrFeNiMn)	0.04		
Pigment Green 17(CrFe-11% Fe)		0.072	
Pigment Green 17(CrFe-34% Fe)			0.047
Chrome Oxide Green		0.03	0.008
Total Pigment Loading:	0.249	0.231	0.214

10 phr TiO2 - Matches have DE<0.8 vs. Std.

Figure 2

..6

Med. Beige Formulas

Average Composition - In phr

	CrFeNiMn(17% Fe)	CrFe(11% Fe)	CrFe(34% Fe)
Pigment Brown 24(CrSbTi)	0.718	0.702	0.881
Pigment Yellow 164(MnSbTi)	0.248	0.127	0.058
Pigment Black 30(CrFeNiMn)	0.173		
Pigment Green 17(CrFe-11% Fe)		0.361	
Pigment Green 17(CrFe-34% Fe)			0.229
Chrome Oxide Green			
Total Pigment Loading:	1.138	1.19	1.168

10 phr TiO2 - Matches have DE<0.6 vs. Std.

Figure 3

Dark Beige Formulas

Average Composition - In phr

	CrFeNiMn(17% Fe)	CrFe(11% Fe)	CrFe(34% Fe)
Pigment Brown 24(CrSbTi)	1.845	1.658	1.91
Pigment Yellow 164(MnSbTi)	0.839	0.314	0.255
Pigment Black 30(CrFeNiMn)	0.744		
Pigment Green 17(CrFe-11% Fe)		1.436	
Pigment Green 17(CrFe-34% Fe)			0.825
Chrome Oxide Green			0.068
Total Pigment Loading:	3.428	3.409	3.058

10 phr TiO2 - Matches have DE<0.6 vs. Std.

Figure 4

7

IR Reflectance of Black Pigments

IR Reflectance(%) vs. Wavelength(nm)

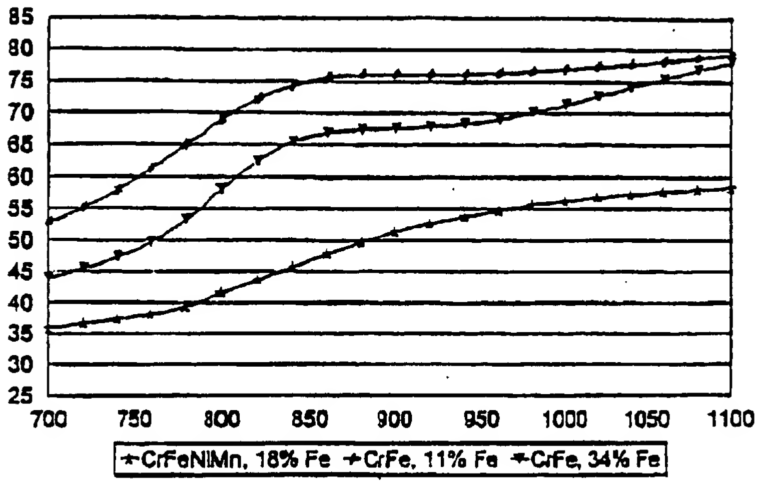
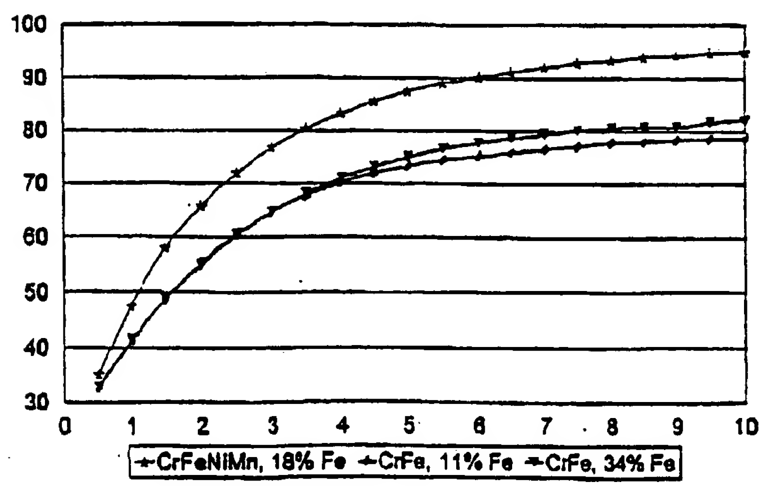


Figure 5

Figure 5

IR Blacks - Heat Build-up

Temperature(deg. C) vs. Time(min.)



8" bulb height - Equal L* values(67.0+/- 0.5)

Figure 6

[redacted]

8

IR Reflectance - Light Beiges

IR Reflectance(%) vs. Wavelength(nm)

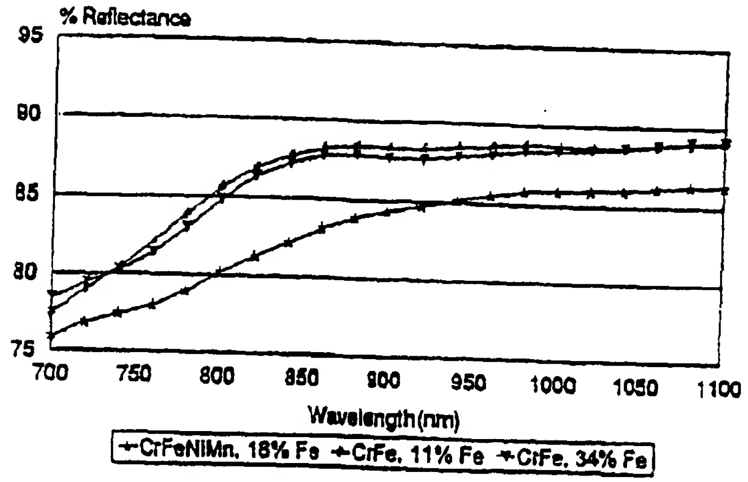


Figure 7

Light Beige Heat Build-up Results

Temp.(Deg. C) vs. Time(min.)

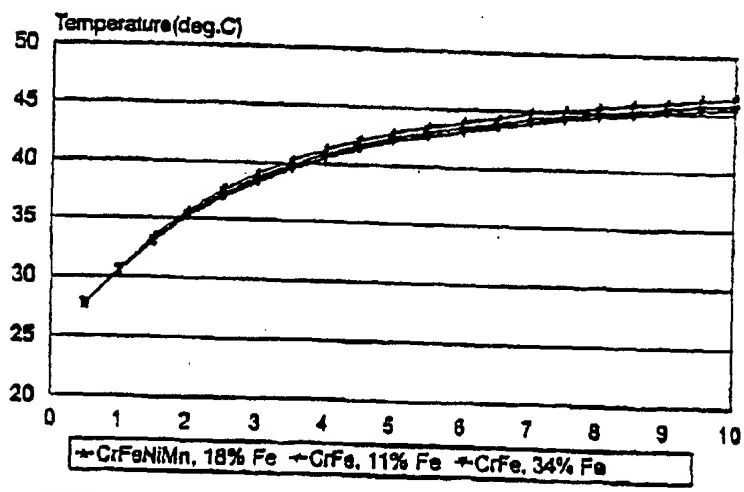


Figure 8

9

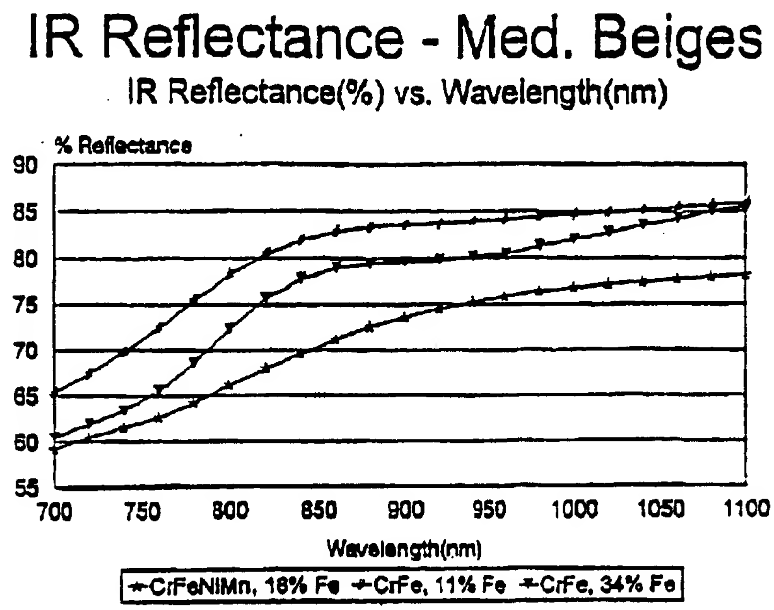


Figure 9

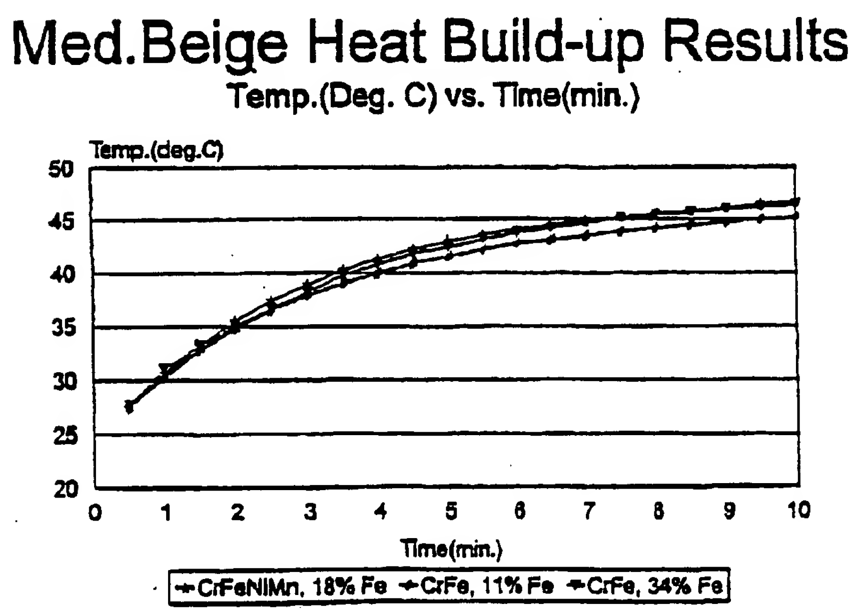


Figure 10

IR Reflectance - Dark Beiges

IR Reflectance(%) vs. Wavelength(nm)

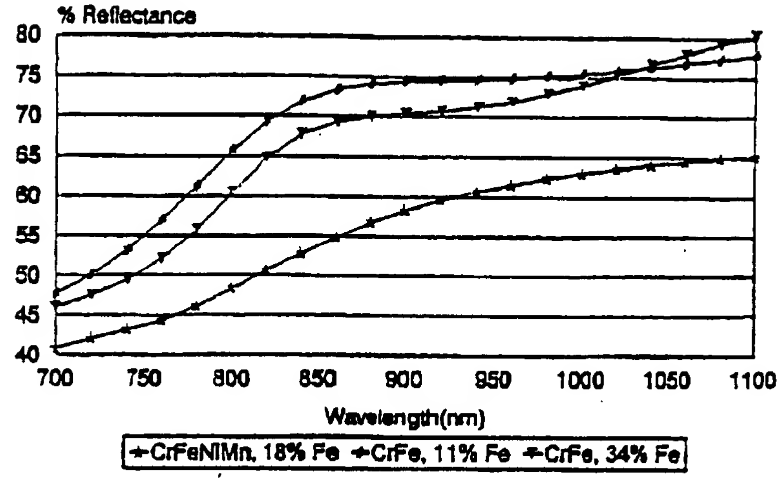


Figure 11

Dark Beige Heat Build-up Results

Temp.(Deg. C) vs. Time(min.)

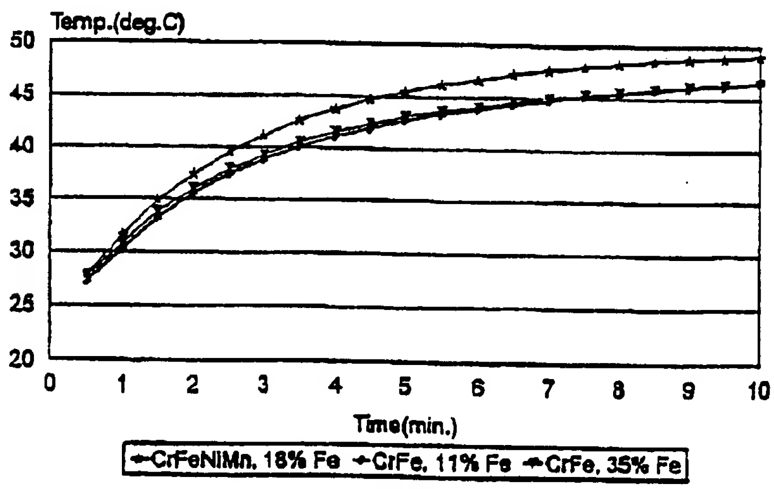


Figure 12

Black Pigment Weathering

S. Florida - 1 year

	CrFeNiMn(17%Fe)	CrFe(11%Fe)	CrFe(34%Fe)
1phr Pigment : 8.5phr TiO2	Avg. L* = 67.7	Avg. L* = 70.8	Avg. L* = 65.4
Delta L*	1.63	2.81	3.49
Delta a*	-0.27	-0.37	-0.74
Delta b*	1.35	0.73	1.13
Delta E	2.18	2.93	3.74

CIELAB Ill. D65 @ 10deg., SCI

Figure 13

Average Weathering Results

S. Florida - 1 year

		CrFeNiMn(17% Fe)	CrFe(11% Fe)	CrFe(34% Fe)
Light Beige:				
	Delta L*	0.41	0.46	0.41
	Delta a*	0	-0.02	-0.03
	Delta b*	0.36	0.37	0.44
	Delta E	0.61	0.62	0.62
Medium Beige:				
	Delta L*	1.02	1.62	1.47
	Delta a*	-0.02	-0.16	-0.17
	Delta b*	-0.41	-0.36	-0.36
	Delta E	1.26	1.72	1.53
Dark Beige:				
	Delta L*	1.52	2.46	1.89
	Delta a*	-0.08	-0.31	-0.2
	Delta b*	0.02	-0.46	-0.04
	Delta E	1.53	2.54	1.77

CIELAB Ill. D65 @ 10deg., SCI

Figure 14

-H2

Avg. Fe Content - in phr

Pigment	Lgt. Beige	Med. Beige	Dk. Beige
C.I. Pig. Black 30(18% Fe)	0.007	0.031	0.134
C.I. Pig. Green 17(11% Fe)	0.008	0.041	0.158
C.I. Pig. Green 17(34% Fe)	0.015	0.078	0.281

Figure 15

Avg. Black Pigment Content - in phr

Pigment	Lgt. Beige	Med. Beige	Dk. Beige
C.I. Pig. Black 30(18% Fe)	0.04	0.173	0.744
C.I. Pig. Green 17(11% Fe)	0.072	0.373	1.436
C.I. Pig. Green 17(34% Fe)	0.043	0.229	0.825

Figure 16

General Information:

Materials/Pigments:

R-PVC Compound - Tin Mercaptide Stabilized Compound

Titanium Dioxide - Industry standard, encapsulated rutile grade

Pigment Brown 24 - CrSbTi, rutile structure

Pigment Yellow 164 - MnSbTi, rutile structure

IR Reflecting Blacks:

Pigment Black 30 - CrFeNiMn, spinel structure - approx. 18% as Fe

Pigment Green 17 - CrFe, Hematite structure - approx. 11% as Fe

Pigment Green 17 - CrFe, Hematite structure - approx. 34% as Fe

Colorimetric Values of Standard Shades:

	L*	a*	b*	C	H
Light Beige	87.5	-0.2	7.8	7.8	91.7
Medium Beige	76.5	0.7	11.4	11.4	86.3
Dark Beige	64.9	1.2	10.1	10.2	83.5

Color Measurement:(for all readings)

CIELAB Illuminant D65 @ 10°, Spectral Component Included

Weathering:

Test Method: ASTM #G7-89 - mounted at 45° facing due South
Location: Miami, FL
Start Date: March 3, 1995

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